SHORT REPORT

Rurality, deprivation, and excess winter mortality: an ecological study

D A Lawlor, R Maxwell, B W Wheeler

J Epidemiol Community Health 2002;**56**:373–374

The reasons for the higher levels of excess winter mortality in Britain, compared with countries with colder winters, are unclear. Ecological studies suggest that both increased outdoor and indoor cold exposure relating to poor housing energy efficiency and lack of adequate clothing and physical activity when outdoors are important.[1 2] It seems plausible that excess winter mortality would be greater in more deprived areas as deprived populations are more likely to live in poor quality energy inefficient housing and are less likely to be car owners. Two British studies have found no association between area deprivation and excess winter mortality, but both were based in single district health authorities and may not have had the power to detect an association.[3 4] Furthermore, both studies were based in urban areas and were unable to assess the association between excess winter mortality and rurality.

It has been suggested that rural areas in Britain are at increased risk of excess winter mortality and that government action should be targeted at these areas. A range of features—poor quality housing, high proportion of detached houses, lack of access to gas networks, and low take up of government energy efficiency grants—may make rural populations vulnerable to indoor cold exposure. Outdoor occupations and poor public transport systems in rural areas may increase outdoor cold exposure.

The aim of this study was to assess the association between both rurality, and area deprivation, and excess winter mortality in a large region of England with a population of nearly six million and a distribution of both urban and rural areas.

METHODS AND RESULTS

The age sex standardised seasonality ratio[3] was calculated for each ward of the South West Region using data aggregated over a five year period 1994–1998. Mortality data by month were obtained from the Office of National Statistics and population data were calculated by linearly projecting between the under-enumeration adjusted 1991 census population estimates and the mid-1996 estimates. Rates were standardised, using the direct method of standardisation, to the WHO European standard population. Confidence intervals for seasonality ratios were calculated using Breslow-Day's method.[5] Population density, a measure of rurality,[6] and Townsend deprivation scores were calculated for each ward using small area statistics data from the 1991 census. Both seasonality ratios and Townsend deprivation scores were normally distributed across the wards. Population density was approximately log normal. Pearson's correlation coefficients and partial coefficients were used to assess the associations between the log of population density and seasonality ratios and between Townsend deprivation scores and seasonality ratios.

Over the five year period of the study 279 513 deaths in total occurred with 54 681 deaths in 1994 (the smallest number) and 56 262 in 1997 (the year with the highest number of deaths). The associations between deprivation and rurality and excess winter mortality were assessed across 1169 wards and we had 85% power to detect a correlation at the 5% level of significance.[7]

Neither population density nor Townsend deprivation scores were associated with excess winter mortality (table 1). Pearson's correlation coefficient (95% confidence intervals) for

Table 1 Trends in seasonality ratio across quintiles of population density and Townsend score

	Population density (rurality)					
Quintiles of ward population density (range of population/km²)	1 (8.07 to 52.87)	2 (52.88 to 142.40)	3 (142.41 to 749.71)	4 (749.72 to 2661.41)	5 (2661.42 to 11974.46)	
Number of wards	234	234	234	234	233	
Seasonality ratio (95% confidence intervals)*	116.32 (112.42 to 120.36)	117.02 (113.82 to 120.30)	117.10 (114.53 to 119.73)	115.90 (113.73 to 118.10)	116.42 (114.48 to 118.39)	P_{trend} 0.3
	Area deprivation					
Quintiles of Townsend deprivation score	1	2	3	4	5	
(range of Townsend score)†	(−6.85 to −2.98)	(−2.97 to −1.73)	(−1.72 to −0.65)	(−0.64 to 0.70)	(0.71 to 9.24)	
Number of wards	234	234	234	233	234	
Seasonality ratio (95% confidence intervals)*	115.28 (112.48 to 118.15)	116.65 (113.76 to 119.60)	118.04 (115.31 to 120.84)	116.50 (114.10 to 118.95)	115.87 (113.83 to 117.95)	P_{trend} 0.6

*Seasonality ratio: mean age sex directly standardised mortality rate in the winter months (December to March) divided by mean age sex directly standardised mortality rate in the non-winter months, expressed as a percentage. Data aggregated over five years 1994–98; †higher scores (highest quintiles) indicate greater deprivation.

the correlation between log population density and seasonality ratio was –0.01 (–0.07 to 0.05) p=0.7 and that between Townsend score and seasonality ratio was –0.04 (–0.10 to 0.02) p=0.2. As population density may be associated with deprivation we assessed the independent association of each using partial correlation coefficients. The partial correlation coefficients adjusting simultaneously for log population density and Townsend score were the same as the unadjusted coefficients: partial correlation coefficient for log population density controlling for Townsend score 0.01 (–0.05 to 0.07) p=0.7 and for Townsend score controlling for log population density –0.04 (–0.10 to 0.02) p=0.2.

When seasonality ratios were calculated for the age group 0 to 64 years only there remained little association between either population density or Townsend score and seasonality ratio: correlation coefficient between log population density and seasonality ratio –0.04 (–0.10 to 0.02) p=0.2 and between Townsend score and seasonality ratio –0.06 (–0.12 to 0.00) p=0.06.

COMMENT

This study confirms, in a larger population, the findings of two previous studies that excess winter mortality is not associated with area deprivation. We have also found that excess winter mortality is not associated with rurality. Although people living in deprived and rural areas are likely to have greater difficulties keeping their houses warm during the winter months they may protect themselves from the extreme effects of cold by wearing extra clothing, living predominantly in one or two heated rooms, and keeping physically active. Alternatively the overall increase in ill health and total mortality associated with deprivation may mask any seasonal variation in deprived groups.

In this study and in previous studies[3 4] Townsend scores have been used as a measure of area deprivation in the assessment of the association between area deprivation and excess winter mortality. The Townsend score is based on car ownership, unemployment, overcrowding, and housing tenure and the strength of association between this score and health outcomes attenuates with increasing age. As most excess winter mortality occurs in older age the Townsend score may be a poor indicator of deprivation in the association with excess winter mortality. When the analysis was restricted to younger age groups there was a weak association with Townsend score. Conclusions from ecological studies are limited by the effect of the ecological fallacy and we have not adjusted for the influence of different numbers of residential homes or differences in temperature between wards. Mean winter temperatures are unlikely to have differed greatly between the wards in the South West region. In a previous study the lack of an association between Townsend scores and excess winter mortality remained unchanged when deaths occurring in nursing or residential homes were removed from the analyses.[3]

There is no agreed definition of rurality and different measures—the Office for National Statistics Ward Classification, distance to nearest neighbour and population density—have all been used to assess rurality in health services research, and been found to be associated with different health outcomes.[6] We chose to use population density as this is most likely to reflect the possible mechanisms—detached housing, lack of access to gas networks, and poor access to public transport—that have been proposed as reasons why there may be an increased risk of excess winter mortality in rural areas.

We conclude that neither rurality nor area deprivation are importantly associated with excess winter mortality. These results cannot be used to suggest that policy aimed at reducing fuel poverty and improving housing energy efficiency might not be appropriately targeted at more deprived groups and rural populations. Excess winter mortality is just one (extreme) health consequence that may be related to fuel poverty and action to combat any kind of poverty should not be undertaken purely on the grounds of health consequences.

ACKNOWLEDGEMENTS

We thank the small area health statistics unit at Imperial College London for provision of under-enumeration adjusted 1991 census population estimates and 1996 population estimates. Population density and deprivation data were derived from the 1991 census, Crown Copyright (ESRC purchase).

Authors' affiliations

D A Lawlor, R Maxwell, B W Wheeler, Department of Social Medicine, University of Bristol, Bristol UK

Funding: funding for the special ONS tape with mortality data by month was provided by South West Region NHS executive. The views expressed in this paper are those of the authors and not necessarily those of the South West NHS executive.

Conflicts of interest: none.

Correspondence to: Dr D Lawlor, Department of Social Medicine, University of Bristol, Canynge Hall, Whiteladies Road, Bristol BS8 2PR, UK; d.a.Lawlor@bristol.ac.uk

Accepted for publication 7 November 2001

REFERENCES

1 **Donaldson GC**, Tchernjavskii VE, Ermakov SP, *et al.* Winter mortality and cold stress in Yekaterinburg, Russia: interview survey. *BMJ* 1998;**316**:514–18.
2 **The Eurowinter group**. Cold exposure and winter mortality from ischaemic heart disease, cerebrovascular disease, respiratory disease and all causes in warm and cold regions of Europe. *Lancet* 1997;**349**:1341–6.
3 **Shah S**, Peacock J. Deprivation and excess winter mortality. *J Epidemiol Community Health* 1999;**53**:499–502.
4 **Lawlor DA**, Harvey D, Dews HG. Investigation of the association between excess winter mortality and socio-economic deprivation. *J Public Health Med* 2000;**22**:176–81.
5 **Breslow NE**, Day NE. *Statistical methods in cancer research. Volume II–The design and analysis of cohort studies.* Lyon: IARC, 1987:61–4, 89–91.
6 **Martin D**, Bringham P, Roderick P. The (mis)representation of rural deprivation. *Environment and Planning A* 2000;**32**:735–51.
7 **Machin D**, Campbell M, Fayers P, *et al. Sample size tables for clinical studies.* 2nd ed. Oxford: Backwell Science, 1997.